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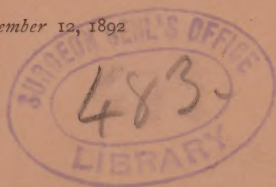
SOME PRACTICAL POINTS IN THE DIAG-
NOSIS OF SPINAL-CORD LESIONS

BY

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Reprinted from the MEDICAL RECORD, November 12, 1892



NEW YORK

TROW DIRECTORY, PRINTING AND BOOKBINDING CO.

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SOME PRACTICAL POINTS IN THE DIAGNOSIS OF SPINAL-CORD LESIONS.

THE spinal cord, while it is a sort of cable carrying messages to and fro between the brain and the periphery, is at the same time to be regarded as a series of thirty-one segments, piled one upon the other, each segment connected with a pair of spinal nerves, and each being a trophic, reflex, and vaso motor centre. These thirty one segments occupy only seventeen or eighteen inches of the spinal canal, which is twenty-six to twenty-eight inches long. Hence, while the first segment of the cord is at the foramen magnum, the thirty-first (or conus) is found opposite the base of the first lumbar vertebra. If one takes a cosmetic pencil it is very easy to draw, on a thin person, an outline of the spinal cord upon the back over the vertebral column, and in this way one gains a clearer knowledge of these puzzling relations than by any amount of reading. The eighth cervical and first dorsal segments are just in front of the spine of the seventh vertebra.

The lumbo-sacral enlargement of the cord begins immediately in front of the tip of the spine of the tenth dorsal vertebra; the conus is just in front of the lower point of the first lumbar spine. Below this point the canal is filled with the cauda equina (lumbar and sacral nerves).

The most important parts of the spinal cord, from a pathological point of view, are the cervical and lumbar portions, or enlargements, for there is an intumescence of

the cord in each of these regions, due to the fact that the sensory, motor, and trophic centres for the arms and hands are in the one, and those for the legs (as well as the reflex centres for the bladder, rectum, and sexual organs) in the other.

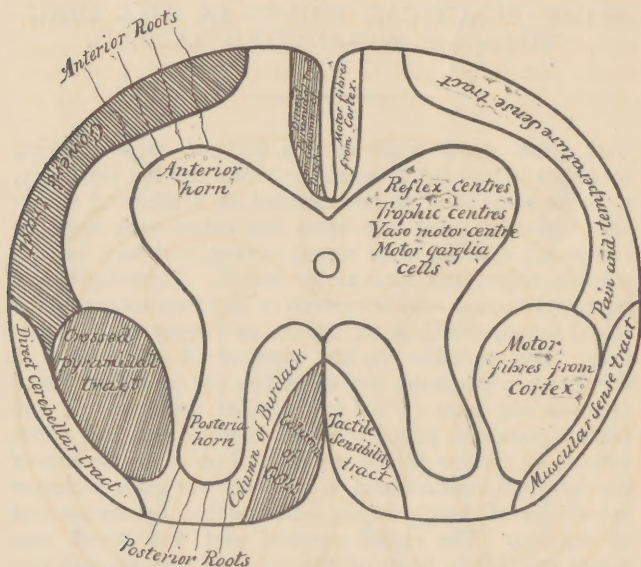


FIG. 1.—Diagram of Transverse Section of the Cord, showing Anatomical Topography on the Left, and Physiological Functions on the Right Side.

The cord consists of “columns” of white matter surrounding the H-shaped central gray. The “columns,” or tracts, contain the long fibres, which transmit peripheral and central impresses and are variously named, as in the diagram (see Fig. 1). The reflex, trophic, and vaso-motor centres are wholly in the gray matter of the cord. The spinal-cord should be regarded, moreover, as consisting of two symmetrical halves, like the brain, with sensory fibres de-

cussating the whole length of the cord, and fibres uniting anterior columns and anterior horns of opposite sides.

There are diseases which attack certain columns, or certain parts of the gray matter, and these are termed system-diseases. The pathological processes are localized in the parts figured in Fig. 2. These "system-diseases," such as polio-myelitis, progressive muscular atrophy, amyotrophic lateral sclerosis, lateral sclerosis, ataxic paraplegia, and locomotor ataxia, are readily recognized by the peculiar symptoms brought about by in-

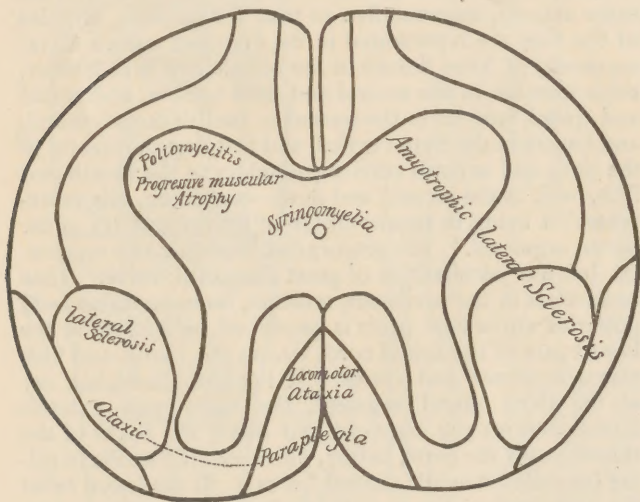


FIG. 2. — A Diagram of the Topographical Situation of Certain Chronic Pathological Processes in the Cord.

jury to certain systems of fibres or cells. This localization is quickly seen in the pathological picture presented above.

But the so-called "focal" diseases of the spinal cord, lesions of limited extent in a particular segment or seg-

ments due to tumors, pressure, hemorrhages, inflammations, spinal injuries, and the like, are not so readily localized, for the symptoms—reflex, trophic, sensory, and motor—are extremely variable, depending as they do upon the segment-level of the pathological process. As regards reflexes, those of the rectum and bladder are abolished by lesion in the fourth and fifth sacral segments and the conus of the cord; ankle-clonus in the fifth lumbar; the knee-jerk in the third lumbar; the wrist and elbow-jerk in the sixth cervical, and so on.

Motor and trophic disorders are also distributed in the same manner, segmentally: so that, for instance, muscles of the toes are represented in the first and second sacral segments, of knee flexors in the fourth and fifth lumbar, thigh muscles in the second and third lumbar, abdominal and spinal muscles in the second to twelfth dorsal, thumb and fingers in the eighth cervical and first dorsal, forearm in the sixth and seventh cervical, shoulder in the fourth and fifth, neck in the second and third—and so on, this representation being in regular order—"lowest muscles in the lowest segments." The sensory distribution is also segmental, but has peculiarities of great diagnostic value. Thus anæsthesia of the perineum, scrotum, rectum, vagina, and posterior surface of penis is produced by a lesion in the lowest part of the spinal cord, viz., in the fourth and fifth sacral segments and conus. If the lesion is higher, say at the third sacral segment, the anæsthesia extends farther out on the buttocks and down the backs of the thighs—over the parts, in fact, which touch a saddle in riding (so-called "saddle-shaped" area). If the lesion be at the fifth lumbar, the anæsthesia includes the outer sides of both legs, and even the outer edges of the feet at times. Now, in order to render all of these facts much clearer than could be accomplished by mere description, I have made two drawings of the most important parts of the spinal cord, from a localization point of view, founded upon the excellent clinical papers of Starr, Herter, Thorburn, and Mills. These parts are the cervical (Fig. 3) and

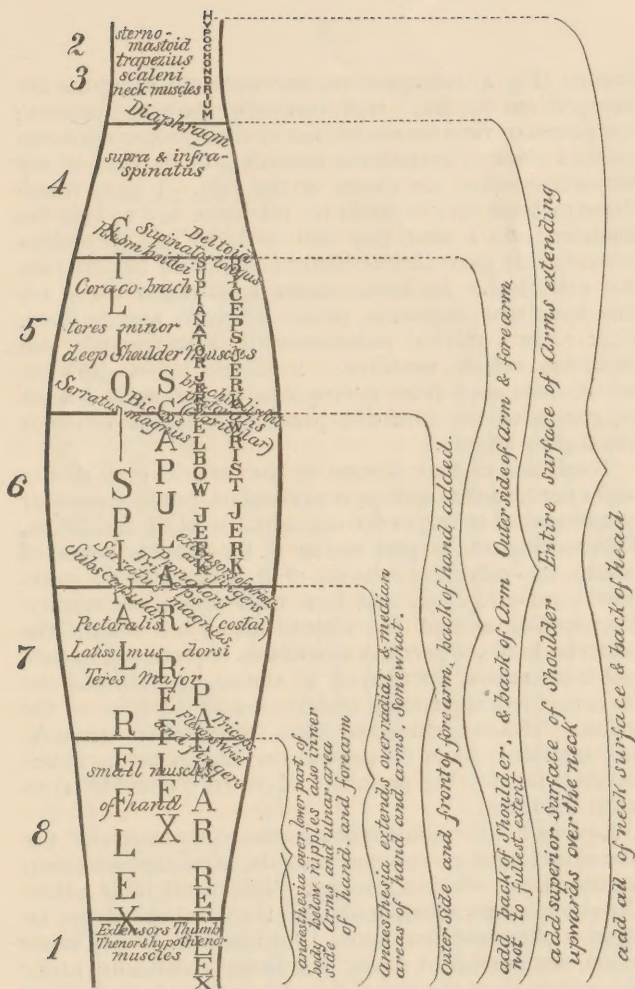


FIG. 3.—Scheme of the Segments of the Cervical Enlargement of the Cord, showing the Reflex Centres, Segmental Representation of Muscles, and, to the Right, the Extent of Anæsthesia produced by Destructive Lesion at Various Levels.

lumbar (Fig. 4) enlargements, and upon the segments are mapped out (in large type vertically) the reflex centres; the names of muscles are written in their proper segments and the areas of anæsthesia, according to the seat of any transverse lesion, are shown at the side. I have found these pictures very valuable for reference and to help the memory, and I trust they will be lucid and helpful to students and general practitioners for whose benefit they are published. In lumbo-sacral localization there are two important diagnostic points which we owe to Starr, viz.: 1. In hysterical anæsthesia the anus, genitals, and perineum remain sensitive. 2. Cauda lesions high up are distinguished from destructive lumbo-sacral lesions by comparatively extensive paralyses when sensation is but slightly affected.

There are chronic lesions in the central gray matter of the cord, such as syringo-myelia, which produce peculiar symptoms according to the segmental level of the lesion. Encroaching on the gray matter of the anterior horns, of course, the particular muscles of that segment are paralyzed and atrophied, and lose their reflex excitability. Encroaching around the central canal and toward the posterior horns, a peculiar anæsthesia is produced to pain and temperature, distributed, of course, according to the particular representations of skin area at the level of the lesion. This is because the fibres for pain and temperature sensibility lie in the central gray matter before entering their tract on the periphery of the cord (see Fig. 1) to reach the brain.

Lesions of the motor tracts in the white matter of the lateral and anterior columns produce muscular weakness, or paresis, but without atrophy. This paralysis is naturally much more widespread than the paralysis caused by injury to the anterior horn. For instance, a very small lesion, say the size of a pea, in a lateral column will probably affect all of the muscles on the same side below that point, the lateral tract being the cable containing nearly all of the long fibres of communication between one side

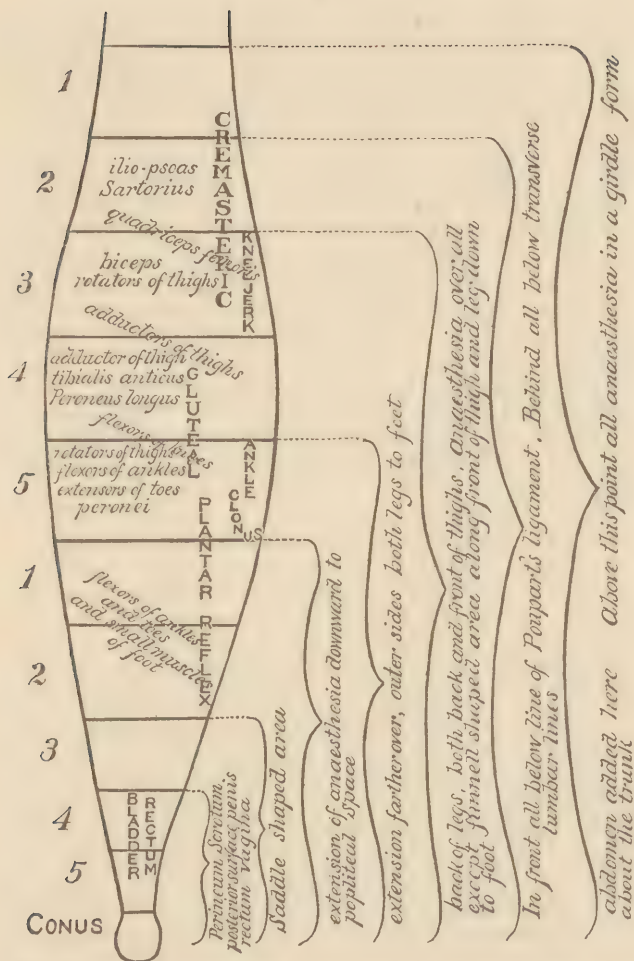


FIG. 4.—Scheme of Lumbo-sacral Enlargement of the Cord for the Same Purpose as Fig. 3.

of the body and one-half of the brain. On the other hand, the same lesion in an anterior horn would produce a very restricted paralysis, affecting only the muscles innervated from that particular segment.

Another feature peculiar to paresis from lateral column injuries is the spastic rigidity with exaggerated tendon reflexes; and still another important point for differential diagnosis is the loss of faradic reaction in paralysis, due to lesion in the anterior horn or motor nerve, and the perfectly normal reaction of these muscles to faradism when the paralysis is due to lesion in the long fibres running from the cortex down the lateral and anterior columns to terminate in the large cells of the anterior horns.

Hence there are four absolutely opposite clinical conditions or symptoms which will serve to differentiate for us the two distinct types of spinal paralysis, the atrophic and the spastic; and these may be conveniently grouped as follows:

Atrophic Spinal Paralysis.

1. Atrophy.
 2. Lost reflexes (such as knee-jerk, wrist-jerk, elbow-jerk, etc.).
 3. Flabby relaxed muscles.
 4. No contraction to faradism.
- Lesion in the anterior horns.

Spastic Spinal Paralysis.

1. No atrophy.
 2. Exaggerated reflexes.
 3. Rigid muscles.
 4. Contraction to faradism.
- Lesion in the lateral columns.

This calls to mind the importance of a complete understanding of the knee-jerk by the general practitioner.

It is of the highest value among the reflex symptoms. The tap upon the tendon sends a sensory impulse to the reflex centre in the anterior horn of the third lumbar segment (*via*, the sensory nerve from the knee-area and posterior root and posterior horn), whence an impulse is reflected outward (*via* anterior root and motor nerve) to contract the quadriceps extensor. While the knee-jerk is, in truth, not a perfect representation of an actual reflex, yet for all practical purposes it may be so considered.

Now, certain fibres from the cortex pass down by way of the lateral columns of the cord to enter the anterior horns, and these hold a rein upon the reflexes, so to say. They inhibit the jerk. Thus, under normal conditions, the knee-jerk is very moderate. If this inhibitory fibre is functionally impaired or destroyed the knee-jerk is no longer restrained but becomes exaggerated. If any part of the reflex arc is destroyed (sensory nerve, posterior nerve-roots, posterior root-zone, posterior horn, anterior

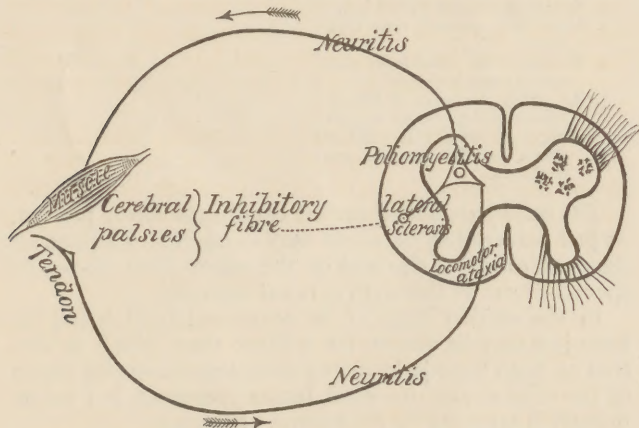


FIG. 5.—Diagram, showing Reflex Arc and Inhibitory Fibre, and some of the Diseases which Exaggerate or Destroy the Knee-jerk.

horn, or motor nerve) the knee-jerk is lost. Thus cerebral palsies, lateral sclerosis exaggerate the knee-jerk; whereas neuritis, locomotor ataxia, polio-myelitis, and the like, destroy the knee-jerk. Fig. 5 is offered as a diagrammatic illustration of these points.

In lesions affecting the inhibitory fibres anywhere all the tendon reflexes below the lesions become exaggerated. Thus ankle-clonus, not normally present in anybody, develops where the lateral column is affected above its centre in the fifth lumbar segment.

A unilateral lesion of the spinal cord gives rise to an interesting syndrome, generally termed Brown-Séquard's paralysis. Suppose that one lateral half of a segment of the mid-dorsal region were destroyed, the result, seen in a typical case some time after the injury, would be :

Same Side.

1. Atrophic paralysis of muscles innervated by that particular half-segment.
2. Spastic paralysis of the leg.
3. Lost or impaired muscular sense.
4. Exaggerated knee-jerk, and usually ankle-clonus.
5. At about the level of the lesion a half-girdle of hyperalgesia, and just below this a parallel zone of anæsthesia.

Opposite Side.

1. Loss of pain, temperature, and touch-sense below the lesion.

The wrist-jerk, under normal conditions rarely present, or just perceptible, becomes very excessive in lesions of the cerebro-spinal segment of the motor tract above its special centre in the sixth cervical segment.

In the earliest stage of an acute unilateral lesion the knee-jerk may be absent for a short time, which is also true of both knee-jerks in any complete transverse lesion of the cord above the third lumbar segment, but subsequently it takes on its over-active character.

The reason that muscular sense is impaired on the same side is that the fibres for muscular sense do not decussate along the spinal cord as do the other sensory fibres.

